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AEC-NASA TECH BRIEF

Analysis of Secondary Cells with Lithium Anodes and Immobilized Fused-Salt Electrolytes

A general discussion is reported (ref. 1) of the possible use of immobilized fused-salt electrolytes in secondary cells with anodes of metallic lithium.

In many of today's applications, power sources are required to have minimum size or weight per unit of power or energy. These requirements have motivated recent work on high-specific-energy and high-specific-power secondary cells. Maximization of the specific energy requires use of reactants of low equivalent weight and high free energy of reaction.

Lithium's very low equivalent weight and low electronegativity make it particularly attractive as an anode material for high-specific-energy cells. Several cathode materials have been used in combination with nonaqueous electrolytes and lithium anodes, depending upon the operating temperature and the electrolyte.

A number of secondary cells with fused-salt electrolytes have been investigated, including sodium-bismuth, lithium-chlorine, lithium-tellurium, and lithium-selenium, all using free-liquid electrolytes. It has been found that a great deal of design flexibility and compactness can be gained by immobilizing the fused-salt electrolyte either in an absorbent matrix or in the form of a rigid paste. This work (ref. 1) deals with secondary cells, having liquid-lithium anodes, liquid-bismuth or tellurium cathodes, and fused lithium halide electrolytes immobilized as rigid pastes, operating at temperatures between 380° and 485°C.

Because of the lower equivalent weight and higher electronegativity, the Li-Te cell has higher specific-energy and specific-power capabilities than the Li-Bi cell. The latter, having three cells per inch and an electrolyte thickness of 0.32 cm, has a specific power of 43 W/lb and a specific energy of 21 W-hr/lb, whereas the Li-Te cell of similar dimensions can attain 110 W/lb and 55 W-hr/lb. The results of the design analysis also indicate that if the electrolyte thickness is decreased to 0.1 cm one can achieve 90 W/lb and 45 W-hr/lb for the Li-Bi cell and 200 W/lb and 110 W-hr/lb for the Li-Te cell.

It is also concluded that acceptable paste electrolytes can be formed from fused lithium halides and inert filler materials; the pastes now show two to three times the expected resistivities. Moreover Li-Bi and Li-Te cells operating with electrolytes of lithium halide paste can operate at power densities of 0.57 and 1.0 W/cm^2, respectively, at about 480°C. These cells can be charged at very high rates (within less than 30 minutes), so that they are possible candidates for many applications where fast recharge is important. Possible applications for secondary cells having the characteristics of the Li-Te cell include power sources in space, military-vehicle propulsion, and special commercial-vehicle propulsion.

Reference:

1. Shimotake, H.; Rogers, G. L.; Cairns, E. J.: Secondary Cells with Lithium Anodes and Immobilized Fused-Salt Electrolytes. Argonne National Laboratory, Dec. 1967.

Notes:

1. This information may interest researchers in energy-conversion devices, electrically powered vehicles, and energy-storage devices.

(continued overleaf)

2. Inquiries concerning this information may be directed to:

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Patent status:

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